Title	Hearing impairment in Vietnamese children : a medical mission-based analysis
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Citation	Lam, M. [林敏琪]. (2013). Hearing impairment in Vietnamese children : a medical mission-based analysis. (Thesis). University of Hong Kong, Pokfulam, Hong Kong SAR.
Issued Date	2013
URL	http://hdl.handle.net/10722/238521
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Hearing impairment in Vietnamese children:

A medical mission-based analysis

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Acknowledgements

The author would like to acknowledge and sincerely thank Ms Paige Stringer, the executive director of the Global Foundation For Children With Hearing Loss, for providing data in this study, and Professor Bradley McPherson for valuable advice and supervision of this study.

A dissertation submitted in partial fulfilment of the requirements for the Bachelor of Science (Speech and Hearing Sciences), The University of Hong Kong, June 30, 2013.

Abstract

A better understanding of hearing disability situation would advance hearing health care in the developing world. Vietnam is a developing country with audiology at its early stage of development. This study examined the situation (degree, types and causes) of hearing impairment, the effects of age and gender on hearing impairment, and the age of identification and its relationship with degree of hearing impairment in Vietnamese children. Sixty nine participants aged from 20 to 129 months with prelingual-onset hearing loss were assessed during Global Foundation For Children With Hearing Loss humanitarian field missions. Data on hearing assessment findings, including case history and pure-tone audiometric outcomes, were analyzed. Results showed that hearing impairment of participants ranged from moderate to profound levels, and that sensorineural pathologies accounted for 80% of hearing loss. Maternal rubella was the most common cause. Age and gender showed no statistically significant associations with degree of hearing impairment. Average age of identification was 23.2 months and a greater proportion of children with profound hearing loss than those with milder degrees were noted. To reduce the prevalence of childhood hearing loss, improved immunization programs against infectious diseases and development of universal newborn hearing screening programs are highly recommended.

Hearing impairment in Vietnamese children:

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The World Health Organization (WHO) estimates that there are approximately 360 million people having disabling hearing impairment in the world at present (WHO, 2013). Almost one tenth of the affected population are children. The majority of the affected population is from the developing world (WHO, 2013).

Hearing impairment in children is frequently caused by infection, either congenital or acquired (Vallely & Klapper, 2009). Maternal rubella is an example of congenital infection, which is a common cause of sensorineural hearing loss. The congenital rubella virus may damage the inner ear of the fetus through transmission from the mother during pregnancy (Vallely & Klapper, 2009). On the other hand, otitis media and other infectious diseases are common acquired infections. In otitis media, bacterial pathogens are trapped in the middle ear because of a congested eustachian tube, resulting in bacterial invasion of the middle ear (Vallely & Klapper, 2009). Apart from infections, hearing impairment can also be inherited or caused by other nongenetic factors such as using ototoxic drugs and prolonged exposure to loud noise (Roizen, 2003). However, a finding of unknown etiology of hearing impairment is not uncommon in most epidemiological studies (Davis, Davis, & Mencher, 2009).

Although half of the existing hearing impairment can be prevented (WHO, 2013), the awareness of the problem is low and the resources to manage the disability are insufficient in

developing countries (Smith, 2008). Developing countries, including Vietnam, are responsible for most hearing aids manufacturing (McPherson, 2011). However, owing to high cost and a lack of professionals for hearing assessment and fitting of hearing aids (Goulios & Patuzzi, 2008), hearing aids are provided to less than one out of 40 persons with hearing impairment who are in need of amplification in the developing world (WHO, 2013).

Vietnam is a lower middle income country with less than one third of the population residing in urban areas. There were a total of 87 million people living in Vietnam in 2010, of which 20 million were children aged from birth to 14 according to the United Nations (2011). The Ministry of Labor, Invalids and Social Affairs (MOLISA) and the United Nations Children's Fund (UNICEF) estimated that there were approximately one million Vietnamese children aged from birth to 17 who had one or more disabilities (MOLISA & UNICEF, 2000). Hearing and speech disabilities accounted for 10% and 21% of all reported disabilities, respectively. In particular, males were found to have a higher reported rate of hearing disabilities than females. Infection is likely to be one of the major causes of hearing impairment in Vietnam. Balle and his colleagues (2000) found that the prevalence of childhood chronic otitis media in Vietnam was 2.1%, and Acuin (2004) noted that Vietnam is a country with a high prevalence rate of chronic suppurative otitis media, which can lead to conductive type of hearing loss in more than half of all the cases. Apart from otitis media, infectious diseases that may have potential impact on hearing are also common in the

community. There were 7,259 reported cases of rubella in Vietnam in the year 2011 (WHO, 2012). Despite the burden of hearing impairment in Vietnam, there is an extremely low awareness of local rehabilitation services, especially for individuals with speech or hearing disabilities (MOLISA & UNICEF, 2000). One in every three children with disabilities has never sought treatment and the proportion is especially high for those living in rural areas. While around 20% of children with sight or vision disabilities are using rehabilitative devices such as glasses, less than 2% of children with speech or hearing disabilities use appropriate devices like hearing aids. It is imperative to address hearing problems in Vietnam and raise public awareness.

The burden of hearing impairment in children is onerous. Early identification and intervention—especially in the first 6 months of life—is crucial for children with hearing impairment for optimal language acquisition outcomes (Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998). The Joint Committee on Infant Hearing (JCIH) urged that an early comprehensive audiological assessment and appropriate intervention should be provided to children with hearing impairment at or before 3 months of age and 6 months of age, respectively (JCIH, 2007). Children with severe to profound hearing impairment are usually diagnosed earlier than those with a lesser degree of hearing impairment (Finckh-Krämer, Spormann-Lagodzinski, Nubel, Hess, & Gross, 1998; Harrison, Roush, & Wallace, 2003). However, many developing countries encounter barriers in launching early hearing screening

programs and follow-up services due to higher priority for life-threatening diseases, unaffordable cost, a lack of human and material resources, and so forth (Olusanya, Luxon, & Wirz, 2004). Several studies have found that children with hearing impairment without early identification and intervention are at a disadvantage for vocabulary skills (Moeller, 2000), as well as for receptive and expressive language development (Kennedy et al., 2006; Yoshinaga-Itano & Apuzzo 1998). This disadvantage creates interpersonal communication difficulties, and adversely affects a child's performance in school and their future socioeconomic prospects (Smith, 2008).

Although the Vietnamese Government is open to inclusive education, early identification of students with disabilities and access to inclusive schools are rare (Villa et al., 2003). As many as 95% of students with disabilities do not gain entrance to schools. There is also a shortage of resources to facilitate learning for students with disabilities. Many households can hardly afford an expensive hearing aid and teachers lack training on educating students with special needs (Villa et al., 2003). In addition, the costs of health care and educational services were higher for children with hearing impairment than their normal hearing counterparts (Schroeder et al., 2006).

Martiniuk, Manouchehrian, Negin, and Zwi (2012) reviewed medical mission reports published since 1985 and found that cleft lip and palate deformities were the most frequently targeted health issues by medical missions. Hearing health care is less frequently focused on

by medical missions. The Global Foundation For Children With Hearing Loss (GFCHL) is one of the few international not-for-profit organizations serving children with hearing impairment worldwide. Since 2010, the Foundation has launched the Vietnam Deaf Education Program, mainly providing hearing assessments, treatment of hearing and speech disorders, and professional and parent training. The program aims at training the trainer to ensure sustainability by, for instance, offering a multiyear summer training program which covers audiology, early intervention, and auditory verbal education for professionals in Vietnam and helps teachers apply skills learned in the summer training to classrooms. In addition, children's hearing aids are checked and adjustment is made whenever necessary. The program has served 38 schools and two hospitals across 20 provinces in Vietnam, benefiting over 900 children with hearing impairment in three years (GFCHL, n.d.).

A better understanding of the hearing disability situation in Vietnam would help address the needs for hearing rehabilitation and advance the development of audiology. Investigation on the causes of hearing impairment may indicate the needs for suitable preventive measures and intervention. Understanding the hearing impairment in Vietnamese children of different gender and age groups may address the needs for hearing services in different groups of children, and thus assist planning for service provision. Findings on age of identification and its possible relationship with degree of hearing impairment can provide insight for structuring management programs, such as in promoting early audiological

evaluation and intervention. As yet there is at present a lack of published research which focuses on the hearing disability situation, patterns of gender and age on childhood hearing impairment, and age of identification in Vietnam. Although several studies have examined the causes of hearing impairment, these investigations were either focused on disability in general (MOLISA & UNICEF, 2000), or limited to exploring a single cause (Balle et al., 2000). In the view of a lack of published research for hearing impairment in Vietnamese children, data collected by the GFCHL in the years 2011 and 2012 were used in the present study to 1) describe the situation (degree, types and suspected causes) of childhood hearing impairment, 2) examine the effects of age and gender on childhood hearing impairment, and 3) investigate the general age of identification and its possible relationship with degree of hearing impairment in Vietnam. Recommendations for hearing rehabilitation and further hearing research in Vietnam were developed.

Method

Participants

The GFCHL collaborated with the Thuan An Education Centre For Disabled Children and provided professional training in schools and hospitals in Vietnam. Children with hearing impairment, who received services in the hearing centre, schools or hospitals, would have an opportunity to enroll in the GFCHL Vietnam Deaf Education Program. They thus obtained a hearing assessment and received hearing aids fitting and/or early intervention.

Therefore, participants in this study were selected by purposive sampling, as all of them participated in the hearing assessment conducted by the Vietnam Deaf Education Program in the years 2011 and 2012. Participants were 69 children with prelingual-onset hearing impairment (40 males and 29 females), residing mainly in south Vietnam. They were aged from 1 year 8 months to 10 years 9 months (mean age = 48.8 months, *SD* = 19.07). All participants had hearing impairment ranging from moderate to profound (mean pure-tone average in better ear = 95.9 dB HL, range = 51.7–125.0 dB, *SD* = 17.37). No other specific medical concerns were reported except two participants had visual impairment and one had developmental delay. See Table 1 for the demographic characteristics of the sample.

Table 1

Demographic characteristics of study sample

Demographic Characteristics	***n* (%)**	**Mean**	***SD***	**Range**
Gender	69			
Male	40 (58%)			
Female	29 (42%)			
Chronological age (in months)	69	48.8	19.07	20–129
12-23	4 (6%)	21.0	0.82	20–22
24-35	9 (13%)	31.2	3.70	26–35
36-47	27 (39%)	42.1	3.57	36–47

48-59	15 (22%)	51.7	2.72	48–56
60-71	7 (10%)	63.0	3.79	60–70
72 +	7 (10%)	92.4	18.96	76–129
Age of identification (in months)	61	23.2	12.82	2–68
Degree of hearing loss (in dB HL)	69	95.9	17.37	51.7–125.0
Moderate (41-55 dB HL)	2 (3%)	52.5	1.13	51.7–53.3
Moderately severe (56-70 dB HL)	4 (6%)	63.3	1.35	61.7–65.0
Severe (71-90 dB HL)	18 (26%)	83.0	6.91	71.0–90.0
Profound (90 + dB HL)	45 (65%)	105.8	9.84	91.0–125.0
Type of hearing loss	30			
Sensorineural	24 (80%)			
Mixed	6 (20%)			
Early Intervention Service	36			
Received	30 (83%)			
Not Received	6 (17%)			

Ethical clearance for this study was granted by the Faculty of Education Research Ethics Committee in the University of Hong Kong. The study was carried out with the permission of the GFCHL by written agreement. All case file information was made anonymous prior to analysis and all data were kept confidential.

Materials

The analysis in this study used data from the 69 hearing assessment reports provided by the GFCHL. A complete hearing report included a participant's hearing-related case history, and results of otoscopy, tympanometry, pure-tone air and bone conduction audiometry. See appendix for a sample of the case history report.

Procedures

The hearing assessment was performed by qualified professional audiologists from the GFCHL during the mission in the years 2011 and 2012. A complete assessment included a hearing-related case history, otoscopy, tympanometry and pure-tone air and bone conduction audiometry. Degree, types and suspected causes of hearing impairment, effects of age and gender on hearing impairment, general age of identification and its relationship with degree of hearing impairment were investigated.

Degree and types of hearing impairment. Audiometric testing was conducted using calibrated clinical audiometers and suitable headphones in a sound-treated environment at the Thuan An Education Centre For Disabled Children, Lai Thieu, Binh Duong Province, Vietnam. Audiometers were calibrated in accordance with the international standards (ISO 389). Ambient noise level was measured at 33 dBA by Lutron Sound Level Meter SL-4001, which was within the maximum allowable ambient sound pressure levels for audiometric testing according to ISO 8253-1. Air conduction thresholds were determined at 0.5, 1.0, and

2.0 kHz for each ear, and pure-tone average was calculated based on the average of these frequencies in the better ear, regardless of configuration of the audiogram. A 5 dB addition was made for no response thresholds in the calculation, for instance, if a no response symbol was written at 90 dB HL the response for the purpose of pure-tone average was taken as 95 dB HL. When reports had missing thresholds, the degree of hearing impairment identified by the audiologists was taken as a reference in estimating the pure-tone average. The Goodman scale modified by Clark (1981) was adopted in this study as this modified scale is commonly used by audiologists to classify pediatric hearing impairment (Haggard & Primus, 1999). Table 1 includes the range of pure-tone averages for each degree of hearing impairment.

As suggested by Newman and Sandridge (2007), conductive hearing loss was characterized by having bone conduction thresholds within normal limits and air conduction thresholds above normal limits. Sensorineural hearing loss was characterized by both air and bone conduction thresholds beyond normal limits, with a within 10 dB difference between the two thresholds (i.e., no or a minimal air-bone gap). Mixed hearing loss was also characterized by both air and bone conduction thresholds exceeding normal limits, but with an air-bone gap greater than 10 dB HL in at least one frequency.

Suspected causes of hearing impairment. Information concerning suspected causes of hearing impairment was extracted from the case history on the hearing assessment reports.

This component included information about maternal health status, family history of hearing loss, suspected etiology and other possible causes. Participants with missing records were excluded in the analysis of suspected causes.

Age and gender on hearing impairment. To investigate the effects of chronological age and gender on degree of hearing impairment, participants were divided into six groups and two groups according to their chronological age and gender, respectively. Table 1 shows the grouping and the number of participants in each group. Pure-tone average of the better ear was used to determine the degree of hearing impairment.

Age of identification and degree of hearing impairment. Age of identification was noted from the assessment reports. To investigate its relationship with degree of hearing impairment, participants were divided according to two categories, degrees of hearing loss (moderate to severe and profound) and age of identification (identified at/before and after 18-month-old). Identified at 18 months was chosen since literature has found that greater degrees of hearing loss are usually identified by this age (Strong, Clark, & Walden, 1994). Participants with no information on age of identification were excluded for this investigation.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) 20.0 for Windows was used for all data analysis on both descriptive and inferential statistics. Due to nonnormality of data and small and unequal sample size, separate analyses of age groups and gender on degree of

hearing impairment were performed. The Kruskal-Wallis test and the independent *t*-test test were used in the analyses of age groups and gender on degree of hearing impairment respectively. Test of difference of proportions using Pearson chi-square test was conducted to investigate the relationship between degree of hearing impairment and age of identification by 18 months of age, as the data were categorical.

Results

Degree and Types of Hearing Impairment

One purpose of this study was to determine the degree and types of hearing impairment in Vietnamese children. Of 69 children, 3% (2/69) had moderate, 6% (4/69) had moderately severe, 26% (18/69) had severe, and 65% (45/69) had profound hearing loss. Thirty out of 69 children provided enough information to determine their type of hearing impairment. More than three quarters of the children (80%, 24/30) had sensorineural hearing loss while 20% (6/30) had mixed hearing loss.

Suspected Causes of Hearing Impairment

Another purpose of this study was to explore the suspected causes contributing to hearing impairment in Vietnamese children. Information about suspected causes of hearing impairment was extracted from the case history on the hearing assessment reports. Fifty five percent (38/69) of all reports provided information on the causes of hearing impairment. Maternal rubella, unknown etiology, heredity and other causes were the major suspected

causes noted from the case history. Maternal rubella, including confirmed cases, suspected cases, and confirmed cases with addition heredity factor, was the most common cause which was stated in nearly half of the cases (45%, 17/38). The second common cause was unknown etiology, which constituted 26% (10/38) of children. Other causes included cochlear malformation noted soon after birth, neonatal jaundice, suspected ototoxic drug effects due to antibiotic treatment of long-term cold, possible head trauma in the child's infancy and fever during pregnancy. Figure 1 shows the proportions of different types of suspected causes of hearing impairment.

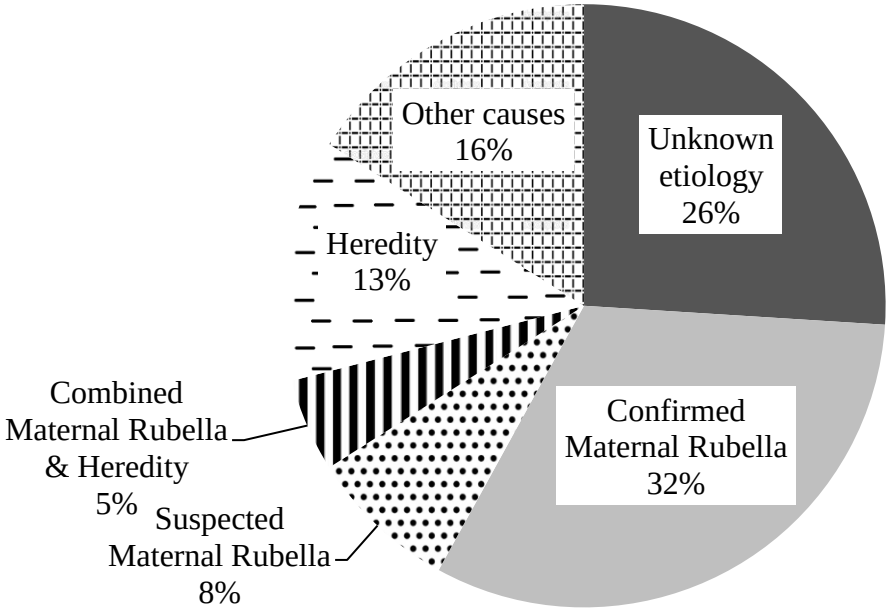

Figure 1. Proportions of suspected causes of hearing impairment in Vietnamese children.

Effects of Age and Gender on Hearing Impairment

Investigating the effects of age and gender groups on degree of hearing impairment in Vietnamese children was another aim of this study. A Shapiro-Wilk test and skewness-kurtosis measures showed normal distribution of pure-tone average data for the

gender groups but not the age groups. Since some of the age group sizes were limited and greatly unbalanced, and the distribution of data was skewed, conducting factorial ANOVA testing would risk inflation of type I error and jeopardize the power of statistics (Harwell, Rubinstein, Hayes, & Olds, 1992). Since factorial ANOVA and other nonparametric alternatives such as Puri and Sen Tests may not be suitable to small group sizes with nonnormal distributions (Toothaker & Newman, 1994), separate analyses of age and gender on degree of hearing impairment were conducted.

Effects of age groups on hearing impairment. Table 2 shows the summary of descriptive information for six age groups on degree of hearing impairment. Since a Shapiro-Wilk test and skewness-kurtosis measures showed a large violation of normality of the data and the group sizes were generally small, the nonparametric Kruskal-Wallis test was conducted as this test provides good control of inflation of error when normality is violated (Lix, Keselman, & Keselman, 1996). No significant effects were found between age groups for degree of hearing impairment, $H(5) = 8.633$, $p = .125$.

Table 2

Descriptive statistics for different age groups and degree of hearing impairment measured in pure-tone average (dB HL)

Age	***n***	***M* (*SD*)**	**Range**	**Skewness**	**Kurtosis**	**S-W test**
12-23 months	4	115.0 (6.83)	108.3–121.7	.000	-5.393	.213*

24-35 months	9	95.7 (17.54)	63.3–116.7	-.573	-.056	.522*
36-47 months	27	98.0 (14.15)	53.3–120.0	-1.005	2.424	.041*
48-59 months	15	89.4 (16.34)	61.7–125.0	.214	.203	.249*
60-71 months	7	100.0 (25.58)	51.7–120.0	-.530	-1.192	.564*
72 months +	7	95.7 (21.04)	63.3–120.0	-.323	-1.056	.742*

Note. S-W test refers to Shapiro-Wilk test.

*$p < .05$.

Effects of gender on hearing impairment. Table 3 shows the summary of descriptive information for gender compared with degree of hearing impairment. Since a Shapiro-Wilk test and skewness-kurtosis measures showed normal distribution of data and Levene's test showed equal variances in both groups, an independent *t*-test was conducted. No significant effects were found between gender for degree of hearing impairment, $t(67) = -1.684$, $p = .097$.

Table 3

Descriptive statistics for gender and degree of hearing impairment measured in pure-tone average (dB HL)

Gender	***n***	***M* (*SD*)**	**Range**	**Skewness**	**Kurtosis**	**S-W test**
Male	40	92.9 (17.88)	51.7–120.0	-.512	-.037	.095*
Female	29	100.0 (16.05)	63.3–125.0	-.612	-.339	.206*

Note. S-W test refers to Shapiro-Wilk test.

*$p < .05$.

Effects of Hearing Impairment on Age of Identification

The last purpose of this study was to examine the general age of identification and its possible relationship with degree of hearing impairment in Vietnamese children. Sixty one out of 69 reports provided data on age of identification. Mean age of identification of the 61 participants was 23.2 months (range = 2–68 months, *SD* = 12.82). Since only two and three participants in the moderate group and moderately severe group respectively had provided information on age of identification, the group sizes were too small for comparison with the severe and profound groups. Therefore, these two small groups were combined with the severe group to form a moderate to severe group. There were 22 participants in the moderate to severe group (mean age of identification = 27.1 months, range = 4.0–47.0 months, *SD* = 10.73) and 39 participants in the profound group (mean age of identification = 20.9 months, range = 2.0–68.0 months, *SD* = 13.5). Figure 2 shows a box-and-whisker plot for age of identification against different degrees of hearing impairment. The moderate to severe group was then compared with the profound group for proportion of children identified at or before 18 months of age, using a test of difference of proportions.

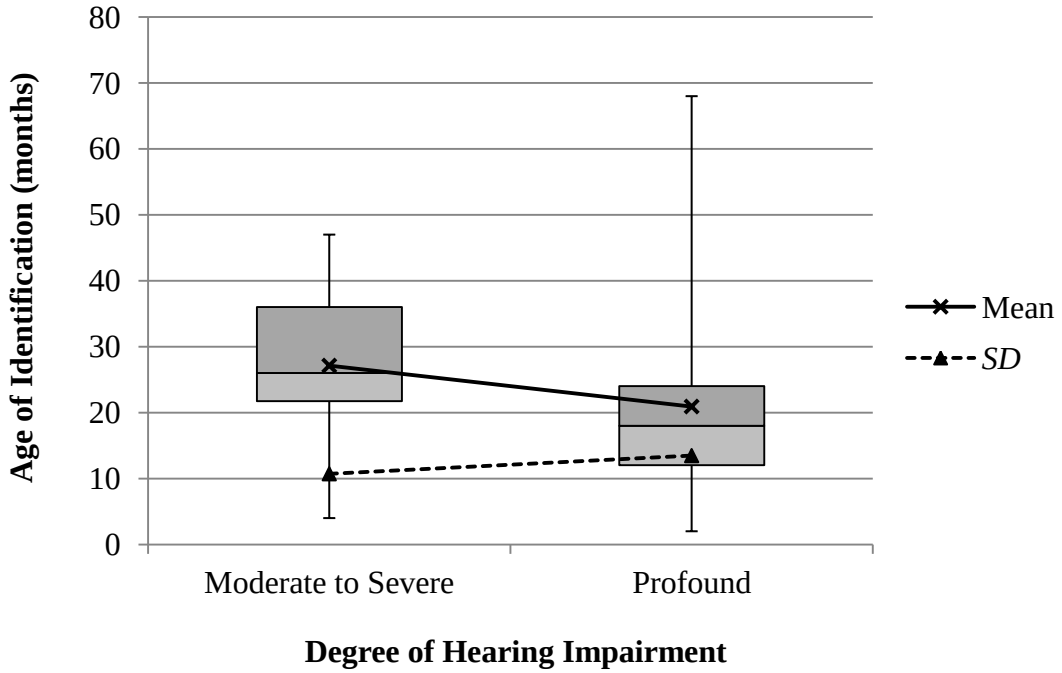

Figure 2. Age of identification of hearing impairment in Vietnamese children against different degrees of hearing impairment.

There were 18% (4/22) of children with moderate to severe hearing impairments and 54% (21/39) of those with profound level being identified at or before 18 months of age. Pearson chi-square test was conducted. The proportion of children with profound hearing loss was found to be significantly greater than the proportion of those with moderate to severe hearing loss, $\chi^2(1) = 7.397$, $p < .05$, with a medium effect size of .35.

Discussion

The present study had three objectives. The first objective was to describe the range, types and suspected causes of hearing impairment found in Vietnamese children. Results showed that participants had hearing impairment ranging from moderate to profound, with nearly two-thirds children having profound hearing impairment. More than three quarters of

participants had sensorineural hearing loss. Maternal rubella was found to be the most frequently ascribed cause of hearing, and this prenatal infection accounted for almost half of all cases. Hearing impairment with unknown etiology was reported in a quarter of all cases.

The distribution of degrees of hearing impairment was skewed in this study, possibly due to sampling bias. Children with hearing impairment who received audiological service from the GFCHL were recruited into this study. Participants were likely to have a predominantly higher degree of hearing impairment, making their parents more motivated to participate in the mission hearing services. This inherent bias may reduce external validity and limit inferences that can be made from the results beyond the sampled population (Tongco, 2007). Despite the possible bias due to purposive sampling, the present study does provide valuable information about the suspected causes of moderate to profound hearing impairment in this under-researched population.

The high prevalence of sensorineural hearing impairment can be explained by the etiologies of hearing loss found in the study. Maternal rubella was a common cause of hearing loss and sensorineural hearing loss is often a consequence of congenital rubella infection (Vallely & Klapper, 2009). The inner ear takes a relatively long time, from the second to the fourth month of pregnancy, to develop. If a pregnant woman suffers from rubella infection, particularly before the fourth month of gestation, the rubella virus may infect the placenta and damage the inner ear of the fetus, causing sensorineural hearing loss.

In addition, the virus can stay in the fluid of the inner ear, causing continuous degeneration of the tissues and resulting in progressive hearing loss (Vallely & Klapper, 2009). Apart from hearing, congenital rubella can also cause other health problems such as visual disability and heart disease (WHO, 2011).

Maternal rubella being a frequent cause of hearing impairment in Vietnamese children was expected. Vaccination for rubella is currently not integrated in the routine immunization program in Vietnam, according to WHO (2012). As a result, in 2011, there were over 7,000 reported cases of rubella, and relatively more reported cases of congenital rubella syndrome in Vietnam compared with other developing countries such as Nigeria (WHO, 2012). The first rubella vaccine was licensed in 1969, and over two third of the WHO member states were using rubella vaccine by 2010 (WHO, 2011). Since prevention by vaccination is the sole way to control rubella infection (Vallely & Klapper, 2009), the Vietnamese government is urged to plan for an immunization program, thus reducing the adverse effects of rubella on hearing, vision and other health conditions.

Hearing impairment with unknown etiology has been commonly reported in both developed and developing countries in the research literature. Wonkam et al. (2013) reviewed several studies and reported that unknown origin accounted for 33% to 54% of childhood hearing loss in different countries in Africa. In a similar review by Mehra, Eavey and Keamy (2009), unknown origin accounted for 56% ($\pm$15.2%) of childhood hearing loss

in the United States. Interestingly, unknown etiology was found in only a quarter of all cases in the present study, possibly due to two reasons. First, there was a high prevalence of maternal rubella, resulting in a relatively small proportion of unknown origin. Second, only 55% of all participants provided information on the suspected causes of their child's hearing disorder. The remaining participants who did not give such information were likely to not know the exact cause for the hearing problem.

The second objective was to examine the effects of age and gender on degree of hearing impairment in Vietnamese children. Owing to nonnormal data with limited and unbalanced age group sizes, the present study could not investigate the interaction effect between age and gender on degree of hearing impairment. Yet, this study does provide some information on the separate effects of each factor on degree of hearing impairment.

A literature review done by Mehra et al. (2009) reported that views on whether prevalence of childhood hearing impairment increases with age were mixed. This study showed no significant effect between different age groups on degree of hearing impairment. However, this finding is doubtful as the group sizes for certain age groups, such as the group of 12 to 23 months, were small, which may not be representative to the population of those age groups.

A gender difference in the prevalence of hearing impairment has been reported in majority of studies (Mehra et al., 2009; MOLISA & UNICEF, 2000). However, a

relationship between gender and degree of hearing impairment was not found in the literature (Strong et al, 1994). Results in this study agree with Strong et al. (1994) in that no significant effect was found between genders on degree of hearing impairment.

The last objective was to investigate the general age of identification and its possible relationship with degree of hearing impairment. Results showed that age of identification varied from 2.0 to 68.0 months with a mean age of 23.2 months. The proportion of children with profound hearing impairment was found to be significantly greater than the proportion of those with moderate to severe hearing impairment at or before 18 months of age.

The research literature indicates that children with severe and profound hearing impairments are generally diagnosed earlier than those with mild and moderate hearing impairment (Finckh-Krämer et al., 1998; Harrison et al., 2003). Due to the skewed distribution of different degrees of hearing impairment, the number of participants in moderate and moderately severe groups was limited. This results in a slight difference between the present study and previous studies in that comparison was made between the moderate to severe group and profound group. Despite this difference, the present study still agrees with other research findings that, generally, the greater the degree of hearing impairment, the earlier the age of identification.

Olusanya et al. (2007) reviewed the performance of newborn hearing screening program across developing countries and found that the average ages of diagnosis of hearing

impairment ranged from 2.0 to 6.0 months. Vietnam, a developing country with absence of a universal newborn hearing screening program, showed an average age of diagnosis of 23.2 months, which is far from the guidelines of three months proposed by the JCIH (2007). Such a late age of identification can be accounted for by a lack of parental awareness and absence of a universal newborn hearing screening program. Parents can be unaware of the suspicious signs of childhood hearing impairment and there is an extremely low awareness of local services available to support hearing disabilities (MOLISA & UNICEF, 2000), leading to poor access to hearing health care services and delayed identification. With a lack of newborn hearing screening programs, appropriate referral for infants at high risk of hearing impairment cannot be made efficiently, resulting in delayed audiological evaluation.

The effectiveness of newborn hearing screening programs has been reported by many studies, such as those in Austria (Weichbold, Nekahm-Heis, & Welzl-Müller, 2005) and in Germany (Neumann et al., 2006). The average ages of identification were greatly reduced from 37.6 to 3.9 months of age in Austria and from 17.8 to 3.1 months of age in Germany. Apart from developed countries, there is evidence that universal newborn hearing screening programs are feasible in developing countries (Olusanya et al., 2007). Although low public awareness, a lack of support from government and limitations in resources are the usual barriers to implementation of screening programs (Olusanya et al., 2007), there have been increased endeavours to combat these challenges in Vietnam. The GFCHL has provided

training to equip teachers, families and medical teams with audiological knowledge and raise local awareness on the implications of childhood hearing impairment and appropriate rehabilitation options (GFCHL, n.d.). Furthermore, representatives from Vietnam were sent to a scientific workshop about promoting newborn screening (Padilla & Therrell, 2012). Although this workshop focused on newborn dried bloodspot screening only, the strategies discussed to overcome the challenges of implementation of such screening programs may form the foundation for the Vietnamese government to plan for other newborn screening programs such as on hearing.

The GFCHL made great contributions to this study by providing valuable data on the childhood hearing impairment situation in Vietnam. The case history covered a wide range of items concerning audiological, medical and family history, child's communication skills and developmental milestones, which provided most of the basic information. However, there were a number of missing data on the assessment reports such as in the section of "causes of hearing loss". These missing data can reduce the representativeness of the sample in research. Therefore, the GFCHL is recommended to include ways to reduce the amount of missing data. For instance, inclusion of several relevant options for the caregivers to choose from can be a way to facilitate retrieval of information and maximize response rate. Since the type of hearing loss could not be determined in a number of cases due to missing

bone conduction thresholds, the GFCHL is also suggested to obtain a complete audiometric profile, if possible, on both air and bone conductions for each participant for future research.

As abovementioned, the biased sampling in this study has limited the application of results to the whole population in Vietnam. Nonnormality of data with small and unbalanced age groups has also restricted the investigation of interaction between age and gender on hearing impairment. As a better understanding of hearing disability situation in the Vietnam population would help advance the local development of audiology, as well as plan for hearing rehabilitation by addressing the needs of hearing services, the present study can be expanded with a greater sample size and a nationally representative range of locations in Vietnam in future research.

To sum up, the present study has provided valuable clinical information concerning Vietnamese children with hearing impairment. The Vietnamese government is urged to plan for an immunization program to reduce the impact of infectious diseases, such as rubella, on hearing impairment. Planning for a universal newborn hearing screening program is also highly recommended as to reduce the age of identification of hearing impairment in Vietnam. In future research, the present study can be expanded with a greater and more representative sample in Vietnam. Last but not least, the GFCHL is suggested to maximize responses from caregivers and obtain a complete audiometric profile on air and bone conductions for each participant, where possible, to facilitate future hearing research in Vietnam.

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Appendix

Case History Report

Child Name:_____ Date of Birth _____ Gender: _____

Parent(s) Name:_____

Child participating in which Summer 2012 Program: Early Intervention ____ Classroom ___

Audiological History—Please provide audiogram if available.

Date hearing loss was identified: _____ Date of last hearing test: _____

Degree of Hearing Loss: Mild/Moderate/Severe/Profound/Not Known

Is there a family history of hearing loss? _____

Date of first hearing aids:_____ How long has child worn current hearing aids? _____

How many hours each day does child wear their hearing aids? : _____

Is child resistant to wearing their hearing aids? : _____

Please check the skills that child is able to do by themselves:

_____ Respond when you call his/her name _____ Turns towards loud sounds

_____ Turns toward quiet sounds _____ Looks for person talking to him/her

_____ Looks for sounds heard nearby _____ Understands some words most of time

Medical History:

Cause of hearing loss (if known): _____

Is child taking any medications? : _____

Does child have any allergies? : _____

Other medical conditions/concerns:_____

What are primary concerns about the child's development? _____

_____